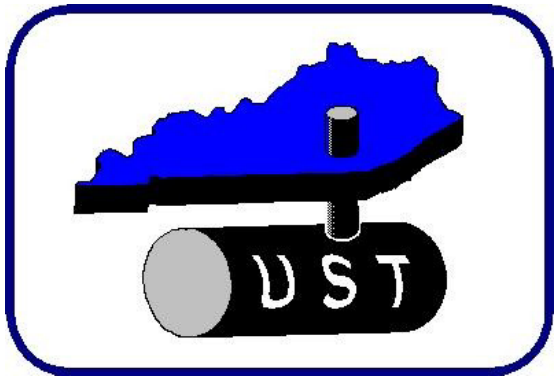
401 KAR 42:060

SITE INVESTIGATION OUTLINE



ENERGY AND ENVIRONMENT CABINET
DIVISION OF WASTE MANAGEMENT
UNDERGROUND STORAGE TANK BRANCH
200 FAIR OAKS LANE, 2ND FLOOR
FRANKFORT, KENTUCKY 40601
502-564-5981

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SITE INVESTIGATION OUTLINE

Energy and Environment Cabinet
Division of Waste Management
Underground Storage Tank Branch
200 Fair Oaks Lane, 2nd Floor
Frankfort, Kentucky 40601
502-564-5981

INTRODUCTION

Owners and operators shall perform a site investigation that will determine the full vertical and horizontal extent of contamination into the soils, surface water or groundwater in accordance with Kentucky Administrative Regulations (KAR) Title 401, Chapter 42:060. The cabinet shall require a site investigation if contamination levels, outside the excavation zone, exceed those outlined in the Classification Outline (August 2006), incorporated by reference in 401 KAR 42:080, for regulated petroleum underground storage tank (UST) system(s), or if contamination levels, outside the excavation zone, exceed those outlined in Tables A and B of this outline or Tables A and B of the Site Check Outline (August 2006), incorporated by reference in 401 KAR 42:060, or in Tables A and B in the Closure Outline (August 2006), incorporated by reference in 401 KAR 42:070, for regulated non-petroleum UST systems. Refer to 401 KAR 42:011 for UST system(s) excluded from this outline.

For definition of terms used within this outline, refer to 401 KAR 30:005 and 42:005.

The purpose of site investigation activities is to define the full vertical and horizontal extent of contamination outside of the excavation zone. The site investigation process shall be recorded in three types of reports: the Initial Site Investigation Report, Intermediate Site Investigation Report(s), and a Final Site Investigation Report. The cabinet will send a written request for all fieldwork required. Each phase of fieldwork will have specific reporting requirements and will include a Site Investigation Checklist form that shall be completed and signed by a Professional Engineer (P.E.) registered with the Kentucky Board of Licensure for Professional Engineers and Land Surveyors, or a Professional Geologist (P.G.) registered with the Kentucky Board of Registration for Professional Geologists.

The Initial Site Investigation Report will be requested by the cabinet to determine if contamination above allowable levels has migrated beyond the tank pit, piping, and dispenser areas. If analytical results from the Initial Site Investigation Report confirm the presence of contamination above allowable levels, then a written request for additional site investigation activities will be sent by the cabinet. The Initial Site Investigation Report shall include, at a minimum, the requirements listed in Section 12.1 of this outline.

Documentation of subsequent site investigation activities shall be submitted in Intermediate Site Investigation Reports. Note that determining the full extent of contamination often will take more than one Intermediate Site Investigation Report. The cabinet will send written requests for additional site investigation activities until the full extent of contamination has been defined. The Intermediate Site Investigation Report shall include, at a minimum, the requirements listed in Section 12.2 of this outline.

When the full extent of soil and/or groundwater contamination above allowable levels has been defined, a written request for a Final Site Investigation Report will be sent by the cabinet. The Final Site Investigation Report shall include, at a minimum, the requirements listed in Section 12.3 of this outline.

Section 1.0 to Section 12.0 of this outline provide the minimum requirements for completing a full site investigation. Section 12.0 lists the reporting requirements for each phase of the site investigation process.

1.0 SITE IDENTIFICATION, LOCATION, AND HISTORY

1.1 Provide the site name, site location (street address, city, and county; including the latitude and longitude of tank pits), and the Agency Interest number.

1.2 Provide the property owner's name, address, and telephone number.

1.3 Provide the site operator's name, address, and telephone number (if different from tank owner).

1.4 Provide information on the historical land use for the site.

1.5 Provide information on population and land use of surrounding properties. Identify nearby UST facilities by Agency Interest number.

1.6 Provide photographs with descriptive captions of site and adjacent properties.

2.0 UST HISTORY

2.1 Provide information regarding previous tank and/or piping closures and UST system releases (UST system release date and incident numbers). Identify current UST systems operating on site (tank sizes and contents).

2.2 Provide a description of other ongoing environmental activities at the site.

2.3 Provide data on the nature and estimated quantity of the UST system release.

2.4 Provide a fume/vapor survey of all buildings and utility lines immediately adjacent to the site (including interviews with adjacent building occupants, use of field instrumentation, inspection of utility manholes, etc.). The fume/vapor survey shall include any structures impacted by the presence of fumes/vapors. The presence or absence of fumes/vapors shall be reported in writing for any phase of field work. Mitigation shall commence immediately if fumes/vapors are detected. See the UST System Release Response and Initial Abatement Requirements Outline (401 KAR 42:060) and the Classification Outline (401 KAR 42:080) for additional information.

3.0 SITE GEOLOGY / HYDROGEOLOGY

3.1 Provide a description of the local and regional geology, hydrogeology, and surface water hydrology based upon reasonably current scientific publications.

3.2 Provide a description of the site geology and hydrogeology based upon information obtained during soil boring and monitoring well drilling activities.

3.3 If the site is located in a carbonate bedrock setting, provide documentation indicating that a hydrogeologic survey was conducted, identifying all relevant features such as sinkholes, sinking streams, caves, and all springs in the locale surrounding the site (includes research of published information and field reconnaissance). Contact the Kentucky Division of Water at 502-564-3410 to obtain any existing information on carbonate bedrock drainage near the site.

4.0 SURFACE WATER AND GROUNDWATER USAGE AND SENSITIVITY

4.1 Provide information concerning the quality and usage of groundwater within a minimum radius of 300 meters (984 feet) from the site. At a minimum, identify all water well users (e.g., public water supply wells, private wells, agriculture and livestock wells, industrial wells, water supply springs, wellhead protection areas, cisterns, etc.) located within this

radius. Field reconnaissance must be performed to confirm the presence or absence of features listed above.

4.2 Provide information concerning the usage of the surface waters within a minimum radius of 300 meters (984 feet) from the UST system(s) located on the site. At a minimum, identify all surface water users (e.g., drinking water intake and distribution points, recreational areas, water usage springs, and agricultural or livestock usage, etc.) located within this radius. Field reconnaissance must be performed to confirm the presence or absence of features listed above.

4.3 If necessary, the cabinet will send a written request for collection and analyses of water samples from any feature listed in Sections 4.1 and 4.2.

4.4 Indicate if the site is on a public water supply.

4.5 Indicate if the water lines adjacent to the site are constructed of PVC (polyvinyl chloride) piping.

Note that Kentucky Geological Survey (KGS) hydrologic searches "report only information in the Kentucky Ground-Water Data Repository and may not be representative of all hydrologic UST facilities (i.e., springs, wells) in the search area. Water wells were not required to be registered with State until 1985" (wording from KGS hydrologic search form).

5.0 MAPS

5.1 An Initial Site Survey shall be completed for the Initial Site Investigation Report. The Initial Site Survey shall establish a site map to be used for future site investigation activities. The Initial Site Survey shall include the property boundaries of the subject site and features located within an approximate 30-meter (100-foot) radius of the UST system excavation zone. Further field work (additional soil borings and/or monitoring wells) shall be surveyed when completed. For subsequent site investigation activities, the cabinet may send a written request for an additional survey if contamination in soil and/or groundwater extends beyond the area covered in the Initial Site Survey. Maps shall be stamped and signed by a Professional Engineer (P.E.) licensed by the Kentucky Board of Licensure for Professional Engineers and Land Surveyors, or a Professional Geologist (P.G.) registered with the Kentucky Board of Registration for Professional Geologists. The Initial Site Survey Map shall be to scale and shall include a North arrow, bar scale and legend, and shall include the following:

a) The excavation zone, buildings, and roadways shall be surveyed. The reference point used for surveying shall be identified; and
b) Approximate property lines, private wells, public wells, cisterns, springs, streams, ponds, lakes, piping, dispenser islands, soil borings, assessment wells, monitoring wells, canopies, railroad tracks, storm sewer catch basins, overhead utilities, buried utilities, items listed in Sections 4.1 and 4.2, wetlands, paved areas, gravel areas, grassy areas, trees, bridges, drainage ditches, fences, inaccessible steep slopes, etc., shall be accurately depicted. Any feature that would obstruct future sample collection shall be identified on a map and in writing (e.g., when a conventional drill rig is used for sample collection, identification of areas with limited space, overhead utilities, etc., is necessary); and
c) If permanent changes (e.g., construction, demolition, utility installations, etc.) are made at a site that would affect an ongoing site investigation, these changes shall be reported to the cabinet. The Initial Site Survey Map shall be amended, as requested by the cabinet, to reflect those changes.

5.2 Provide a Vicinity Map for the site and surrounding properties. The Vicinity Map does not have to be surveyed (but should be roughly to scale). It shall depict adjacent properties within 100 meters (328 feet) of the site (businesses, residences, other UST sites and their corresponding Agency Interest numbers, etc.). The Vicinity Map shall be submitted with the Initial Site Investigation Report or as requested by the cabinet.

5.3 Provide the portion of the 7.5-minute USGS (United States Geological Survey) Topographic Map depicting the location of the site. The portion of the Topographic Map submitted shall indicate the name of the map, latitude and longitude labels, and a map scale. The Topographic Map shall be submitted with the Initial Site Investigation Report or as requested by the cabinet.

5.4 Provide the portion of the 7.5-minute USGS Geologic Quadrangle Map depicting the location of the site. The portion of the Geologic Quadrangle Map submitted shall indicate the name of the map, latitude and longitude labels, and a map scale. The Geologic Quadrangle Map shall be submitted with the Initial Site Investigation Report or as requested by the cabinet.

5.5 A groundwater potentiometric surface map shall be submitted for each groundwater sampling and gauging event. The groundwater flow direction shall be shown on the map with an arrow. Equipotential lines shall be properly labeled. Equipotential lines shall agree with the data. The map shall be supported by the data and shall not include equipotential representations outside the area covered by the data. Data from different sampling events shall not be included on the same map or represented as being equivalent or simultaneous. The Initial Site Survey Map shall be used as a base map for groundwater potentiometric surface maps.

5.6 Provide a contaminant plume map that depicts the extent of contamination for the site (and adjacent properties, if affected) for each phase of site investigation. As applicable, a soil plume map and a groundwater plume map shall be submitted. Analytical data results shall be listed adjacent to sample locations on soil and groundwater plume maps. Plume delineation lines shall agree with the data. The map shall be supported by the data and shall not include areas that have not been assessed and supported by data from soil borings and/or monitoring wells. The Initial Site Survey Map shall be used as a base map for plume maps. Contaminant Plume Maps shall be submitted as requested by the cabinet.

6.0 FIELD INVESTIGATIONS – SOIL

For soil samples collected during any phase of site investigation activities, the cabinet will require, in writing, the collection of soil samples using a grid-based approach to delineate the vertical and horizontal extent of soil contamination. Reporting for each phase of site investigation shall include a discussion of soil sample collection, handling, and preservation. The following steps shall be followed for soil sample collection and handling at sample locations designated by the cabinet.

6.1 The cabinet will send a written request that identifies required soil sampling locations on a site map overlain by a grid with grid blocks designated where soil borings shall be advanced.

6.2 Soil borings shall be advanced at the center of the designated grid block, unless otherwise specifically required by the cabinet. Where buildings, structures, utility conduits, trees, or other features obstruct the center of the block, the soil boring shall be advanced within the available space as near as possible to the center of the grid block.

6.3 Exact soil sample intervals for each sample location will be identified in written correspondence from the cabinet. Continuous soil collection and continuous soil screening is required at each soil boring location. The entire soil section from within a directed interval shall be collected and field screened with a properly calibrated PID (photoionization detector) or FID (flame ionization detector). The portion of the directed interval with the highest field screening reading shall be submitted for laboratory analysis. If field screening does not indicate the presence of contamination within a directed interval, a soil sample from the deepest portion of that interval shall be submitted for laboratory analysis. Proper calibration of PID or FID meters shall be documented in any site investigation report submitted to the cabinet.

6.4 A soil sample from the termination depth of the deepest interval or from the soil-bedrock interface shall be analyzed.

6.5 Acceptable soil collection methods include conventional drill rigs (e.g., soil sample collection via drill rig/hollow-stem auger/split-spoon sampler), direct-push technology, and hand augering. Written approval from the cabinet is necessary for other soil collection methodology.

6.6 Collection of soil samples and transfer of soil samples from the sampling device to the sample container should minimize disturbance and the amount of time that the sample is exposed to air. Soil sample collection, handling, and preservation shall be achieved in a manner that reduces the loss of VOC (volatile organic compound) contamination due to volatilization and biodegradation. Sample collection and handling shall prevent cross contamination between samples and between sample locations. Samples shall be placed into containers with zero headspace, stored on ice at 4°C or less (plus or minus 2°C), etc. Soil samples shall be analyzed for the appropriate constituents (see Section 10.0 for sample handling, analysis, etc.). Documentation of soil sample collection, handling, and preservation procedures shall be reported for all field work. For VOC analyses, analytical results for soil samples collected from auger cuttings or from auger flights will not be accepted by the cabinet.

6.7 A soil boring log shall be submitted for each soil boring. PID or FID readings corresponding to depth shall be recorded on each soil boring log. Soil boring logs shall include detailed descriptions including thickness, color, texture, grain sorting, grain size, and grain shape of soil; a description of lenses or thin layers encountered; the presence or absence of water and free product (and the depths that water or product were encountered); etc.

6.8 For any report detailing site investigation activities, all analytical data for soil shall be reported in a historical soil data table that includes the sample identification number, depth sampled, date sampled, and the analytical results in mg/kg. Soil results from site check and/or tank/piping closure activities shall be included in the historical soil data table. The table shall include the appropriate allowable levels in mg/kg for the constituents of concern.

6.9 All borings (soil borings and additional borings required for the Final Site Investigation Report) shall be properly decommissioned immediately after obtaining a sample. Proper decommissioning is achieved by sealing the boring with cement/bentonite or bentonite from bottom to top in a manner that prevents communication of surface water and groundwater through the boring and to prevent communication between two or more water-bearing zones through the boring. (Note that if a soil boring is to be converted to a monitoring well, then the soil boring does not need to be properly decommissioned prior to monitoring well installation.)

6.10 Cross sections of the site that correspond to soil borings and/or monitoring wells, that adequately illustrate the variation of the geology, and that depict the flow conditions of the hydrogeology of the site shall be submitted for the Final Site Investigation Report. (Note that the cabinet may require the submittal of cross sections prior to the Final Site Investigation Report to assist delineation of contamination.) Seasonal and short-term variations of groundwater flow conditions shall be depicted. Cross sections shall be drawn to scale (vertical and horizontal) with a legend. All data points and cross section lines on the map shall be accurately labeled.

6.11 If a soil boring cannot be advanced in the designated grid block as requested, the soil boring shall be advanced in an adjacent grid block based on probable contaminant pathway as determined by the best professional judgment of the oversight personnel. Photographic documentation shall be included in the report submitted to support the need for alternate boring placement.

6.12 The owner/operator/contractor/consultant bears the responsibility of exploring, identifying, and addressing all potential safety hazards throughout the course of field work.

6.13 If free product is *initially* discovered during site investigation activities, contact the UST Branch for a determination of necessary action.

7.0 FIELD INVESTIGATIONS – GROUNDWATER

If collection of groundwater samples is required for any phase of site investigation, the cabinet will send a written request requiring the collection of groundwater samples. Groundwater investigation will utilize a grid-based approach for selecting monitoring well locations. Each phase of site investigation shall include a discussion of groundwater sample collection and handling. The following steps shall be followed for groundwater sample collection, handling, and preservation at sample locations designated by the cabinet.

7.1 The cabinet will send a written request that identifies groundwater sampling locations on a site map overlain by a grid with grid blocks designated where monitoring wells shall be constructed. If directed by the cabinet, installation of assessment wells may be required. For more information about assessment wells, refer to Closure Outline (August 2006), incorporated by reference in 401 KAR 42:070.

7.2 Groundwater monitoring locations shall be at the center of the designated grid block, unless otherwise specifically requested by the cabinet. Where buildings, structures, utility conduits, trees, or other features obstruct the center of the block, the groundwater monitoring location shall be within the available space as near as possible to the center of the grid block.

7.3 If collection of soil samples during monitoring well installation is directed, see Section 6.0 for the soil sampling protocol.

7.4 Monitoring and assessment wells shall be properly purged to obtain groundwater samples that are representative of the groundwater at the site. Collection and transfer of a groundwater sample from the sampling device to the sample container should minimize disturbance and the amount of time that the sample is exposed to air. Groundwater sample collection, handling, and preservation shall be achieved in a manner that reduces the loss of VOC contamination due to volatilization and biodegradation. Sample collection shall minimize sample agitation. Sample collection and handling shall prevent cross contamination between samples and between sample locations. Samples shall be placed into containers with zero headspace, with the appropriate preservative, stored on ice at 4°C or less (plus or minus 2°C), etc. Groundwater samples shall be analyzed for the appropriate constituents (see Section 10.0 for sample handling, analysis, etc.). Provide a summary of groundwater sample collection, handling, and preservation procedures.

7.5 The depth to water in each monitoring well shall be gauged every time groundwater samples are collected. Each time a monitoring well is sampled, the date gauged, the elevation of the top of casing (top of casing should be marked for consistent measurements), depth to water, the groundwater elevation, screened interval, and a sample description (turbidity, odor, sheen, etc.) shall be recorded in a table and reported, in writing, to the cabinet. Include the monitoring well name and AKGWA number in the table. For each sampling event, a groundwater potentiometric surface map shall be submitted (see Section 5.5 of this outline for groundwater potentiometric surface map requirements). Each site investigation report shall discuss trends in groundwater flow direction and groundwater fluctuations with regard to potential movement and distribution of contamination (e.g., smear zones).

7.6 For any report detailing site investigation activities, all analytical data for groundwater shall be reported in a historical groundwater data table that includes the sample identification number, date sampled, and the analytical results in mg/L. Include the

monitoring well name and AKGWA number in the table. Groundwater analytical results from site check and/or tank/piping closure activities shall be included in the historical groundwater data table. The table shall include the appropriate allowable levels in mg/L for the constituents of concern.

7.7 Monitoring and assessment wells shall be drilled only by a driller certified to drill monitoring wells in accordance with KRS 223.400 to 223.460 and with 401 KAR 6:320. A monitoring well record form (DEP8043) shall be submitted to the UST Branch and the Division of Water for all wells constructed in accordance to 401 KAR 6:310. Documentation shall be submitted indicating that all monitoring wells were properly drilled, constructed, altered, decommissioned, and reported in accordance with 401 KAR 6:310 and this outline. The documentation shall indicate that the following requirements were met:

a) Precautions shall be taken during drilling and construction of monitoring wells to avoid the introduction of contaminants into a borehole. Only potable water shall be used in drilling monitoring wells. Drilling muds shall not be used without prior written approval of the cabinet. (Air systems and drilling lubricants shall not introduce contaminants into the boreholes.)

b) Decontamination of all equipment to be placed into a borehole shall be performed before use at the site and between construction of separate boreholes. Where possible, monitoring wells located hydrogeologically up-gradient shall be drilled first.

c) Monitoring wells shall be cased as follows:

1) The casing shall be constructed in a manner to prevent communication of surface water and groundwater through the boring and to prevent communication between two or more water-bearing zones through the boring.
2) A minimum casing diameter of two (2) inches shall be used. A four (4) inch or greater minimum casing diameter will be required if the well is to be used for recovery of free product or removal of water for remediation purposes (unless otherwise approved by the cabinet).
3) Monitoring well screens and filter packs shall be installed in a manner that enables collection of groundwater samples at appropriate depths (i.e., the screened interval shall be constructed so that it intersects the surface of the groundwater table and accounts for seasonal fluctuations in the static water level).
4) The well casing shall extend at least one (1) foot above the ground surface, or shall have a flush-mounted manhole casing with a watertight seal where necessary. All monitoring well casings shall have a functional watertight locking cap installed.
5) The drill-hole diameter shall be a minimum of four (4) inches larger than the outside diameter of the well casing.
6) The filter pack shall extend at least one (1) foot above the top of the monitoring well's screened interval.
7) The annular space shall be sealed with a minimum of twenty-four (24) inches of bentonite above the filter pack. The bentonite seal shall be properly hydrated in accordance with the manufacturer's recommendations.
8) If PVC casing is used for monitoring well construction, a thread and gasket seal shall be used to preclude potential sample contamination from solvent-welded joints, unless otherwise approved by the cabinet.

d) Monitoring well casings shall be enclosed in a protective cover that shall be:

1) sufficient to reliably protect the well from damage (this shall include a protective barrier around the well);
2) grouted and placed with a cement collar below the frost line to hold it firmly in position, unless otherwise approved by the cabinet;
3) be numbered and painted in a highly visible color;
4) made of steel or any other material of equivalent strength; and
5) protrude at least one (1) inch higher than the monitoring well casing.

e) Monitoring wells shall have a concrete pad (at least four (4) inches thick) that extends a minimum radius of one (1) foot from the center of the well (e.g. a 2x2 well pad) and slopes away from the well or the flush-mounted manhole.

f) Monitoring wells shall be properly decommissioned by a certified well driller within

thirty (30) days of the date of determination that the monitoring well is unsuitable for use as a monitoring well or within thirty (30) days of receiving a no further action letter from the cabinet. Proper decommissioning is achieved by removing the casing and sealing the borehole with cement/bentonite or bentonite from bottom to top in a manner that prevents communication of surface water and groundwater through the well or boring and that prevents communication between two or more water-bearing zones through the well or boring.

g) A written approval from the Division of Water is necessary for any variance in monitoring well drilling, construction, alteration, tagging, or decommissioning. Contact the Division of Water at 502-564-3410 for more information regarding water well construction practices and standards (401 KAR 6:310) or water well driller certification (401 KAR 6:320).
h) Monitoring wells shall be properly maintained throughout site investigation and corrective action activities. If a monitoring well is in a state of disrepair (e.g., cracked concrete pad, damaged protective casing, etc.), the monitoring well shall be properly repaired or decommissioned (if repair is not possible). Maintenance, modification, or repair to monitoring wells shall be reported to the Division of Water in writing. Any construction, alteration, or repair of a monitoring well shall be conducted by a certified water well driller in accordance with KRS 223.400 to 223.460 and 401 KAR 6:320. A Monitoring Well Record Form (DEP8043) shall be submitted to the cabinet (a copy to the UST Branch and the original to the Division of Water) for any well that has been constructed, altered, repaired, or decommissioned. The UST Branch must be notified in writing if reimbursement is sought for monitoring well maintenance, modification, or repair. Requests for reimbursement for monitoring well modification or repair shall include photographs that document the damaged monitoring well.
i) Owners/operators/contractors/consultants shall ensure that all monitoring wells are properly marked and accessible (e.g., monitoring wells shall not be paved over).
j) Monitoring wells shall be properly developed after installation and prior to the collection of groundwater samples from monitoring wells. Groundwater samples shall not be collected from a monitoring well for at least 48 hours after the monitoring well was installed (to allow well materials to cure and the subsurface to equilibrate).
k) Schematic construction diagrams shall be submitted to the UST Branch. The schematic construction diagrams shall, at a minimum, accurately depict the depth of the screen interval, riser casing interval, filter pack, bentonite seal thickness, and grout seal thickness. A written description of the procedures followed to ensure the integrity of the monitoring wells (e.g., locking caps, watertight seals, concrete pads) shall be submitted.

7.8 Provide documentation indicating that the drilling activities, if conducted, were terminated when bedrock was encountered in carbonate bedrock areas with potential subsurface solution channel flow. Site investigation activities shall initially include monitoring wells being placed into unconsolidated material only. After the evaluation of the monitoring wells in the unconsolidated material and the hydrogeologic investigation has been completed, deeper bedrock monitoring wells may be required on a site-specific basis. (Note that site-specific conditions (e.g., shallow bedrock) may prohibit the installation of overburden monitoring wells at the initiation of site investigation activities.) When a written request for bedrock monitoring wells is sent by the cabinet, special installation techniques that prevent cross-contamination of aquifers may have to be performed.

7.9 When a contractor's/consultant's professional opinion is that assessment of groundwater in bedrock is necessary, a proposal from a P.E. or P.G. shall be submitted to the cabinet in writing. Bedrock monitoring wells shall be installed only if requested by the cabinet in writing.

7.10 When a contractor's/consultant's professional opinion is that installation of piezometers is necessary, a proposal from a P.E. or P.G. shall be submitted to the cabinet. Piezometers shall be installed only if requested by the cabinet in writing. Note that analytical results for a groundwater sample collected from a piezometer will not be accepted by the cabinet unless the piezometer was installed by a certified monitoring well driller.

7.11 For Intermediate Site Investigation Report activities, the cabinet may require additional

field measurements for groundwater. These additional field measurements may include: dissolved oxygen (DO), oxidation-reduction potential (ORP), temperature, pH, specific conductance, and total dissolved solids (TDS). Note that sample collection via bailing may not be appropriate for some field measurements because of sample agitation (e.g., DO, ORP). Direct measurement devices (down-hole probes) or flow-through measurement instruments (flow-through cells) and low-flow pumps may be used to more accurately and reliably characterize groundwater. The additional field measurements will be required for the Final Site Investigation Report.

7.12 Cross sections of the site that correspond to soil borings and/or monitoring wells, that adequately illustrate the variation of the geology, and that depict the flow conditions of the hydrogeology of the site shall be submitted for the Final Site Investigation Report. (Note that the cabinet may require the submittal of cross sections prior to the Final Site Investigation Report to assist delineation of contamination.) Seasonal and short-term variations of groundwater flow conditions shall be depicted. Cross sections shall be drawn to scale (vertical and horizontal) with a legend. All data points and cross-section lines on the map shall be accurately labeled.

7.13 If a monitoring well or an assessment well cannot be advanced in the designated grid block as requested, the monitoring well or an assessment well shall be installed in an adjacent grid block based on probable contaminant pathway as determined by the best professional judgment of the oversight personnel. Photographic documentation shall be included in the report submitted to support the need for alternate well placement.

7.14 The owner/operator/contractor/consultant bears the responsibility of exploring, identifying, and addressing all potential safety hazards throughout the course of field work.

7.15 If free product is *initially* discovered during site investigation activities, contact the UST Branch for a determination of necessary action.

8.0 ADDITIONAL ENVIRONMENTAL PARAMETERS (FOR FINAL SITE INVESTIGATION REPORT)

When the full extent of contamination above allowable levels in soil and/or groundwater has been defined, the cabinet may require a Final Site Investigation Report. To complete the Final Site Investigation Report, a final sampling event may be required (soil and/or groundwater samples). Additionally, the Final Site Investigation Report shall include results for additional environmental parameters as required by Section 8.1, 8.2, or 8.3 shown below. The additional environmental parameters required by the cabinet will depend on the media affected at the site.

8.1 Additional environmental parameters for UST facilities with soil contamination only:

- soil moisture content
- intrinsic soil permeability
- soil pH
- soil oxidation-reduction potential
- grain size analysis

8.2 Additional environmental parameters for UST facilities with groundwater contamination only:

- grain size analysis
- pump test or slug test
- aquifer porosity
- total organic nitrogen
- inorganic nitrogen
- iron
- sulfate
- CO2
- dissolved oxygen
- oxidation-reduction potential
- temperature
- pH
- specific conductance
- total dissolved solids

8.3 Additional environmental parameters for UST facilities with soil and groundwater contamination:

- soil moisture content
- intrinsic soil permeability
- soil pH
- grain size analysis
- pump test or slug test
- total organic nitrogen
- inorganic nitrogen
- iron
- sulfate
- CO2
- dissolved oxygen
- oxidation-reduction potential
- temperature
- pH
- specific conductance
- total dissolved solids

Once the extent of contamination has been defined, the cabinet shall direct the next course of action (e.g., Corrective Action Plan (CAP), interim corrective action, or monitor only for soil and/or groundwater contamination).

9.0 DECONTAMINATION AND WASTE DISPOSAL

9.1 To prevent cross contamination, all down-hole equipment (drilling tools, soil and groundwater sampling tools, water level meters, etc.) shall be properly decontaminated prior to and between boreholes.

9.2 Provide a summary of the handling and storage of waste generated during the field investigation (development/purge water, soil cuttings, etc.), and submit documentation regarding the proper handling and proper disposal of the waste (e.g., chain-of-custody, waste manifest, receipts, etc.). If wastes are determined to be hazardous, contact the Hazardous Waste Branch, Division of Waste Management, at 502-564-6716 or 800-923-4273, for additional requirements pertaining to waste disposal, manifesting, registration, etc.

9.3 All submitted reports shall include the amount of containerized waste generated and disposed.

10.0 ANALYTICAL REQUIREMENTS AND RESULTS

10.1 Provide documentation indicating that recognized methods, pursuant to 40 CFR 260.11, in accordance with US EPA SW-846, were followed for sample collection, sample preservation, sampling equipment, decontamination procedures, sample containers, sample size, and maximum sample holding times (see Table C). Samples shall be delivered to an appropriate materials testing laboratory for the analysis required (see Tables A and B). The date the sample was collected, received, analyzed, and percent surrogate recovery, as well as all the US EPA SW-846 methods used to extract and analyze the sample, shall be indicated on the laboratory report. The laboratory report shall follow the US EPA SW-846 requirements. Analytical data sheets from the laboratory shall be submitted for site investigation reports.

10.2 Provide chain-of-custody documentation that identifies who has had possession of the sample, the time of possession, and where the sample has been from the time of collection until the laboratory accepts it. The chain-of-custody shall indicate the method of preservation and the temperature at which the samples were received by the laboratory. Chain-of-custody procedures shall be followed to ensure the validity of all samples. If the chain-of-custody is not maintained (e.g., if someone leaves a sample unattended), then the integrity of the sample is compromised and may be rejected by the cabinet. The chain-of-custody shall be developed as indicated by US EPA SW-846 requirements and shall be attached to all analytical results submitted.

10.3 For more information concerning sample analytical requirements, see section 5.0 of the Closure Outline (August 2006) incorporated by reference in 401 KAR 42:070.

10.4 Site investigation reports submitted to the cabinet shall discuss the validity of any flagged data (surrogate recovery data out of range, samples received at high temperature, etc.). An opinion about the validity of analytical results may be submitted from the laboratory.

11.0 OFF-SITE ACCESS REQUESTS

11.1 If soil and/or groundwater contamination extends off-site, contamination on adjacent properties shall be defined. If an off-site property owner denies property access, a written denial must be submitted to the cabinet.

11.2 If a written denial is not obtained, a certified letter requesting off-site access must be sent to the off-site property owner with a 14-day response deadline. If there is no response from the off-site property owner, then one additional certified letter must be sent with a 14-day response deadline. If there is no response to the second certified letter, submit both copies of the off-site access request letters with the certification of delivery cards to the cabinet. Provide the off-site property owner's name, mailing address, and telephone number(s) to the cabinet.

12.0 SITE INVESTIGATION REPORTING

Summaries of site investigation activities shall be submitted in three types of reports: the Initial Site Investigation Report, Intermediate Site Investigation Report(s), and a Final Site Investigation Report. The minimum requirements for each report are listed in this section. For Intermediate Site Investigation Reports, submitting summaries of information for Sections 1-4 is not necessary if information for those sections does not change. The Final Site Investigation Report shall include an update of all sections of this outline (e.g., the general discussion of the geology/hydrogeology of the site submitted in the Initial Site Investigation Report shall be revised to reflect site-specific information collected during subsequent site investigation activities).

All site investigation reports shall include a conclusions section and a recommendations section that proposes the next course of action for the site. The conclusion section shall include a discussion of trends in analytical data and field measurements.

A signed Site Investigation Checklist Form DEP 8049 (August 2006) shall be submitted with each site investigation report. The Site Investigation Checklist Form DEP 8049 (August 2006) and the instructions for completing the form are located at the end of this outline (after Tables A, B, and C). Submit an original and one (1) copy to the cabinet for each report requested. Site investigation reports shall include, but are not limited to, the items shown below.

12.1 The Initial Site Investigation Report shall include:

- An introduction that summarizes most recent field activities including details of sample collection, handling, and preservation, depth to bedrock, depth to groundwater, hydraulic gradient, etc.;
- narrative that summarizes Sections 1-12;
- amended Classification Guide (if necessary), see 401 KAR 42:080;
- analytical data sheets and chains of custody for most recent samples;
- table of all historical soil data (including site check and/or tank/piping closure data); table of all historical groundwater data; and table of historical gauging data for monitoring wells;
- maps as required in Section 5.0;
- soil boring logs and monitoring well forms;
- photographs (if requested) (e.g., receptors, gross contamination in soil, free product, areas where drilling will be difficult, monitoring well pad conditions, etc.);

- a conclusions and recommendations section; and
- a completed Site Investigation Checklist DEP 8049 (August 2006).

12.2 The Intermediate Site Investigation Report(s) shall include:

- An introduction that summarizes most recent field activities including details of sample collection, handling, and preservation, depth to bedrock, depth to groundwater, hydraulic gradient, etc. (note that narratives for Sections 1-4 are not required for Intermediate Site Investigation Reports);
- amended Classification Guide (if necessary), see 401 KAR 42:080;
- laboratory data sheets and chains of custody for most recent samples;
- table of all historical soil data (including site check and/or tank/piping closure data); table of all historical groundwater data; table of historical field measurements (if performed – see Section 7.11); and table of historical gauging data for monitoring wells;
- cross sections (if requested);
- maps as required in Section 5.0;
- soil boring logs and monitoring well forms;
- photographs (if requested) (e.g., receptors, gross contamination in soil, free product, areas where drilling will be difficult, monitoring well pad conditions, etc.);
- a conclusions and recommendations section; and
- a completed Site Investigation Checklist DEP 8049 (August 2006).

12.3 The Final Site Investigation Report shall include:

- An introduction that summarizes most recent field activities including details of sample collection, handling, and preservation, depth to bedrock, depth to groundwater, hydraulic gradient, etc.;
- narrative that summarizes Sections 1-12 with updated information based on field observations (for example, the geology/hydrogeology section might be more specific based on site investigation activities);
- amended Classification Guide (if necessary), see 401 KAR 42:080;
- laboratory data sheets and chains of custody for most recent samples;
- table of all historical soil data (including site check and/or tank/piping closure data); table of all historical groundwater data; and table of historical gauging data for monitoring wells;
- a summary/discussion of additional environmental parameter results;
- cross sections;
- maps as required in Section 5.0;
- soil boring logs and monitoring well forms;
- photographs (if requested) (e.g., receptors, gross contamination in soil, free product, areas where drilling will be difficult, monitoring well pad conditions, etc.);
- summary of additional environmental parameters (Section 8.0);
- a conclusions and recommendations section; and
- a completed Site Investigation Checklist DEP 8049 (August 2006).

13.0 OTHER CONSIDERATIONS

13.1 Review the Closure Outline (August 2006), which is incorporated by reference in 401 KAR 42:070.

13.2 Review the Classification Outline (August 2006), which is incorporated by reference in 401 KAR 42:080 for additional information.

13.3 Review the Corrective Action Plan (CAP) Outline (August 2006), which is incorporated by reference in 401 KAR 42:060 for additional information. For remediation work during site

investigation activities, the CAP Outline addresses interim corrective actions and reimbursement for interim corrective actions.

13.4 Pursuant to 401 KAR 42:060, which adopts the requirements of 40 CFR 280.66, owners/operators may, in the interest of minimizing environmental contamination and promoting more effective cleanup, begin cleanup of soil and groundwater before the Corrective Action Plan is accepted, provided the cabinet is notified in writing of the intention to begin cleanup. The cabinet may impose conditions on the implementation of the interim actions. Interim corrective action activities will not be reimbursed unless approved by the cabinet in writing. The owner/operator should be aware that certain types of corrective action (e.g., injection wells or recovery/pumping wells) or lack of corrective action may allow a UST system release to migrate to areas that were previously unaffected.

13.5 For information about financial assistance for remediation, contact the UST Branch's Claims and Payments Section at 200 Fair Oaks Lane, 2nd Floor, Frankfort, Kentucky 40601 or call 502-564-5981.

13.6 For information about the Kentucky Monitoring Well Record Form (DEP-8043) or decommissioning of monitoring wells, contact the Division of Water, 200 Fair Oaks Lane, 4th Floor, Frankfort, Kentucky, 40601, or call 502-564-3410.

13.7 The cabinet may request information on the UST system history during site investigation activities (any system repair history, tank/line tightness test results, etc.).

13.8 For specific summaries for soil and/or climatological conditions by county, the United States Department of Agriculture Soil Conservation Service publishes soil surveys for counties in Kentucky.

13.9 For specific precipitation data from 165 climate stations across the state, Western Kentucky University's Kentucky Climate Center can be contacted at 270-745-5983. Online requests can be completed at http://kyclim.wku.edu/climate. Similar information can be obtained at http://wwwagwx.ca.uky.edu/climdata.html.

13.10 The cabinet may request a bedrock contour map based on site-specific information obtained during site investigation activities.

13.11 The cabinet may request a dye-trace study based on site-specific information obtained during site investigation activities.

13.12 If the site has an active UST system, the cabinet may request a tank and line tightness test during site investigation activities.

13.13 The cabinet reserves the right to require additional information. The owner/operator will be contacted, in writing, by the cabinet if more information is required.

13.14 The owner/operator/contractor/consultant bears the responsibility of exploring, identifying and addressing all potential safety hazards throughout the course of their work.

Table A

Analytical Requirements for Soil Samples

Product stored in UST System	Required Analysis	Acceptable Method	Maximum Acceptable Reporting Limit
Gasoline, Kerosene, or Jet Fuel	BTEX	Method 5030 in conjunction with SW-846 8240, 8260, 8020, or 8021	B: <0.01 ppm T: <0.7 ppm E: <0.9 ppm X: <5.0 ppm
Diesel or regulated Heating Oil	PAH	Method 3540 or 3550 in conjunction with SW-846 8100, 8270, or 8310	Ch: <15 ppm B(a)A: <0.15 ppm c PAH: <0.3 ppm n PAH: <3.0 ppm NAP: <1.0 ppm
Waste Oil	PAH	Method 3540 or 3550 in conjunction with SW-846 8100, 8270, or 8310	Ch: <15 ppm B(a)A <0.15 ppm c PAH: <0.3 ppm n PAH: <3.0 ppm NAP: <1.0 ppm
	Total Lead	SW-846 7420, 7421, or 6010	Total Lead: <50 ppm
New Oil	PAH	Method 3540 or 3550 in conjunction with SW-846 8100, 8270, or 8310	Ch: <15 ppm B(a)A: <0.15 ppm c PAH: <0.3 ppm n PAH: <3.0 ppm NAP: <1.0 ppm
Other Petroleum or Non-Petroleum	Contact the UST Branch		

BTEX: Benzene, Toluene, Ethylbenzene, and Xylene (total)
PAH: Polynuclear Aromatic Hydrocarbons
Ch: Allowable level individually for Chrysene
B(a)A: Allowable level individually for Benzo(a)anthracene
c PAH: Maximum Acceptable Reporting Limit Individually for Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, and Indeno(1,2,3-cd)pyrene
n PAH: Maximum Acceptable Reporting Limit Individually for Acenaphthene, Acenaphthylene, Anthracene, Benzo(ghi)perylene, Fluoranthene, Fluorene, Phenanthrene and Pyrene
NAP: Naphthalene
ppm: parts per million (mg/kg)

Table B

Analytical Requirements for Water Samples

Product stored in UST System	Required Analysis	Acceptable Method	Maximum Acceptable Reporting Limit
Gasoline, Kerosene, or Jet Fuel	BTEX	Method 5030 in conjunction with SW-846 8240, 8260, 8020, or 8021	B: <0.005 ppm T: <1.0 ppm E: <0.7 ppm X: <10.0 ppm
Diesel or regulated Heating Oil	c PAH n PAH NAP	Method 3510 or 3520 in conjunction with SW-846 8100, 8270, or 8310	c PAH: <0.005 ppm n PAH: <3.0 ppm NAP: <0.3 ppm
Waste Oil	c PAH n PAH NAP Total Lead	Method 3510 or 3520 in conjunction with SW-846 8100, 8270, 8310 SW-846 7420, 7421, or 6010	c PAH: <0.005 ppm n PAH: <3.0 ppm NAP: <0.3 ppm Total Lead <0.015 ppm
New Oil	c PAH n PAH NAP	Method 3510 or 3520 in conjunction with SW-846 8100, 8270, 8310	c PAH: <0.005 ppm n PAH: <3.0 ppm NAP: <0.3 ppm
*	MTBE as required by the cabinet	Method 5030 in conjunction with SW-846 8240, 8260, 8020, or 8021	MTBE: <0.005 ppm
Other Petroleum or Non-Petroleum	Contact the UST Branch		

BTEX: Benzene, Toluene, Ethylbenzene, and Xylene (total)
PAH: Polynuclear Aromatic Hydrocarbons
c PAH: Maximum Acceptable Reporting Limit Individually for Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, and Indeno(1,2,3-cd)pyrene
n PAH: Maximum Acceptable Reporting Limit Individually for Acenaphthene, Acenaphthylene, Anthracene, Benzo(ghi)perylene, Fluoranthene, Fluorene, Phenanthrene, and Pyrene
NAP: Naphthalene
* MTBE sampling as required by the cabinet for domestic use water sources only
ppm: parts per million (mg/L)

Table C

Appropriate Containers, Sample Sizes, Preservation Techniques and Maximum Holding Times*

Parameter	Container Type	Sample Size	Preservation Method	Holding Times (Maximum)
Volatile Organics for Soil (BTEX)	Wide-mouth glass w/ Teflon lined cap	120 ml or 4 oz.	Cool to 4EC	14 days
Volatile Organics for Water (BTEX; MTBE)	Two (2) clear glass w/ Teflon-lined cap (VOA)	40 ml or 1 oz.	Add four drops of HCl to ea., Cool to 4°C	14 days
Polynuclear Aromatic Hydrocarbons for Soil (PAH)	Wide-mouth glass w/ Teflon-lined cap	250 ml or 8 oz.	Cool to 4°C	14 days until lab extraction; 40 days after lab extraction
Polynuclear Aromatic Hydrocarbons for Water (PAH)	Amber glass w/Teflon-lined cap	1 liter	Cool to 4°C	7 days until lab extraction; 40 days after lab extraction
Total Lead for Soil	Wide-mouth glass w/ Teflon-lined cap	500 ml or 16 oz.	N/A	180 days
Total Lead for Water	Plastic or glass	500 ml or 16 oz.	Add HNO3 until pH is less than 2, cool to 4°C	180 days
Volatile Organics for Sludge (TCLP)	Wide-mouth glass w/ Teflon-lined cap	120 ml or 4 oz.	Cool to 4°C	14 days until lab extraction 14 days after lab extraction
Acid/Base/Neutral for Sludge (TCLP)	Wide-mouth glass w/ Teflon-lined cap	120 ml or 4 oz.	Cool to 4°C	14 days (hold) 7 days until lab extraction; 40 days after lab extraction
Metals for Sludge (TCLP)	Wide-mouth glass w/ Teflon-lined cap	500 ml or 16 oz.	Cool to 4°C	180 days until lab extraction 180 days after lab extraction
Mercury for Sludge (TCLP)	Wide-mouth glass w/ Teflon-lined cap	500 ml or 16 oz.	Cool to 4°C	28 days until lab extraction 28 days after lab extraction

- FOR FURTHER INFORMATION REFER TO US EPA SW-846 PUBLICATION.